

The Application of Concepts from Multiple Courses in Creating a Useful App for the University

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Abstract

For individuals not familiar with Doane University, finding their way around the 300-acre campus can be a bit tricky. A need was identified for a solution that would help navigate the campus. Combining concepts and experience gained from a Geographical Information Systems (GIS) course, a mobile applications course and a design patterns course, along with learning to develop on a new platform, a solution has been created as part of a senior seminar project.

The solution is an iOS application (Doane Map), created using the Swift programming language in the XCode integrated development environment. The application utilizes a topical map of the campus created with ArcGIS software, GPS functionality, and the model view controller (MVC) pattern. It provides any student, staff member, or visitor of Doane University a way to easily visualize and navigate the campus using their smartphone. With the app, the user has the ability to create a list of classrooms stored locally on the device. This list ultimately gives the student the ability to quickly learn and track their class schedule, including the classroom location. Another potential use for the application would be giving virtual campus tours to visitors such as prospective students and alumni.

The paper and presentation will include:

- The concepts learned and applied from a GIS course using the ArcGIS software including creating topical layers, feature classes, and shapefiles.
 - The concepts learned and applied from an Android-based mobile applications course including working on a mobile platform, utilizing the tools of a smartphone (GPS), and the overall structure of a mobile app.
 - The concepts learned and applied from a design patterns course including the MVC design pattern.
 - The independent learning applied in IOS development including the Swift programming language, XCode, and the process for submitting an application to the App store.
 - The challenges encountered in the development of the application, and how they were addressed.
 - A virtual demonstration of the application.
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With over 300-acres of land and 38 buildings on Doane University's campus in Crete, NE, almost every new student, parent, or staff member has trouble finding their way around. For anyone new to a college or university, familiarizing yourself with the campus as quickly as possible can be crucial to being successful early on. By combining the concepts learned from several courses as well as some independent learning, an iOS app called *Doane Map* was created as a solution.

A geographic information system (GIS) is a framework for collecting, analyzing, and managing data in order to visualize the world in a meaningful way ("What Is GIS," 2018). GIS is used in almost every industry because it can identify trends, monitor change, and solve problems. While taking introduction to GIS, the decision was made to use this technology for a senior project. In the class, a foundation knowledge set was first developed for the many uses of GIS and the development of it over time. In the course, the text "Getting to Know ArcGIS" was used. This provided numerous assignments that highlighted the many uses of ArcMap; one of the most popular GIS programs around. Learned was the creation data sets, topical layers, and using expressions to interpret spatial data a step further. Also learned was the process of digitizing a map. "Digitizing in GIS is the converting of geographic data either from a hardcopy or a scanned image into vector data by tracing the features" (Dempsey, 2013). For *Doane Map* this method was used to create an overlay image for the Doane University campus. As pictured below (Figure 1), all of the buildings, trails, parking lots, and more were created by digitizing an existing map. The colors for each category were chosen in order to easily distinguish things. For example, all buildings are the color orange, and all fields are green. The walking trails on the campus are shown as red dotted lines and the streets are gray lines.

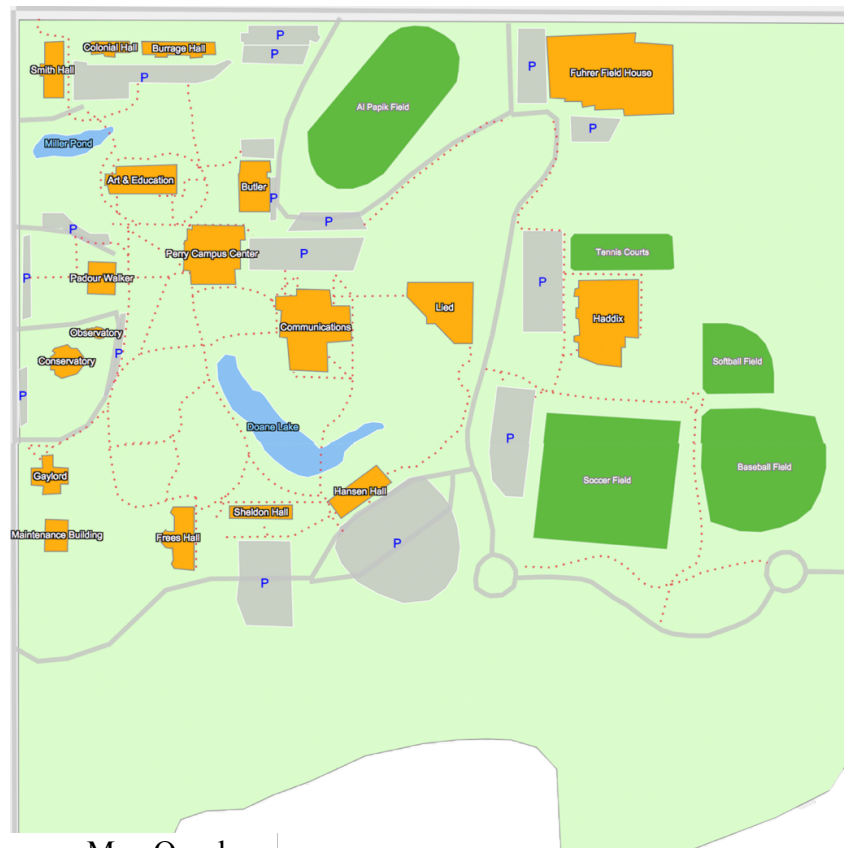


Figure 1: Campus Map Overlay

Mobile app development is a fast-growing industry. There is a constant demand for mobile app development due to the continual release of new devices, operating systems, and several other factors. Through a mobile app course which used Java to create Android applications, experience was first gained for developing in a mobile environment. One concept that was focused on was creating multiple views which the user could navigate between. Also, the course allowed for the developing apps which utilized the phone's hardware such as the gyroscope, GPS sensor, touch screen, and camera. Another concept studied in the course was using constraints to produce consistent looking apps across different device sizes. All of these concepts were carried over to create a solution for navigating Doane's campus with ease. The most important feature which was carried over to the project was utilizing GPS. Smartphones today have the ability to use GPS for showing the user's location. *Doane Map* relies on this feature in order to provide directions to each building on campus. When the user decides to get directions, a polyline is drawn from the user's location to the destination. This line follows trails and roads, depending on the mode of transportation.

In software engineering, a design pattern is a general repeatable solution to a commonly occurring problem in software design (source: sourcecode.com). In a sense, design patterns aren't code reuse, but rather they are experience reuse. Design patterns can be considered templates because they provide solutions for common problems that have already been solved. Most have heard of the model view controller design pattern because of how commonly used it is. This design pattern divides an application into three interconnected parts so it is commonly used in developing user interfaces. By using XCode and swift, this design pattern was utilized in the application. *Doane Map* contains several views (created using an interface builder), a view controller for each view, and a classroom model class which allows for storing the user's classes. Together, the three different types of objects are able to communicate with each other in order to allow the app to work.

Along with several concepts applied from courses, there was some independent learning required for this project. With existing experience in creating mobile apps for the Android environment, the decision was made to develop the app for iOS. Prior to the project, there was little to no experience with the XCode integrated development environment, or the Swift programming language. Several tutorials from Apple, ArcGIS, and YouTube were followed to gain a better understanding of the material. Also, the text "Swift Programming: The Big Nerd Ranch Guide" was purchased and used as a reference. After a great amount of independent learning, there was enough foundation knowledge in XCode and Swift to start developing the app.

Along the way, additional research was done when problems arose. Specifically, research was done to understand how to implement Core Data into project. This allows the app to store a list of classrooms into the user's local storage on the device. Prior to implementing Core Data, the created list would disappear as soon as the app was closed. As the developing of the application continued, there was a need for creating a list of locations on campus. This list included the location name, latitude, longitude, description, as well as an image. Eventually this list was hardcoded into the project by creating custom location class objects. The entire list of locations was then stored in an array which could be easily searched.

Over the course of this project, several challenges were faced which affected the outcome of the application. Initially, an effort was made toward using the ArcGIS iOS development package.

This allowed for creating and displaying an ArcGIS web map by using a map object. After implementing the app with this package, it was discovered that additional licenses were needed if this project was to be published. To solve this issue, XCode's existing map API was implemented. Shortly another issue arose with the mapping feature of the application. Although XCode provided a built-in map API that had the ability to programmatically gather directions, these directions didn't utilize the walking trails as pictured on the campus map. A final solution was discovered, which included implementing Google's iOS map API. With this in place, the feature was added which allows user to switch between walking and driving for the transportation mode.

When the app was nearing its completion, additional steps were required in order to publish it on the App store. Specifically, an Apple developer account was necessary for this step. Preparing the app for the upload was a lengthy process. A description, screenshots, and app icons had to be produced along with the source code. After the app had been uploaded, an Apple quality assurance employee had to review the project before it could be released on the app store. This is a standard procedure that Apple follows in order to ensure the creation of quality apps for their customers.

Any student, staff member, or visitor of Doane University can download the free app "Doane Map" from the app store. The app has three main tabs towards the bottom of the screen that the user can easily switch between (Popular Locations, Map, and My Classes). Figure 2 below displays an overview of the application which illustrates the segues between the different views. A description of each view along with an image can be found further below.

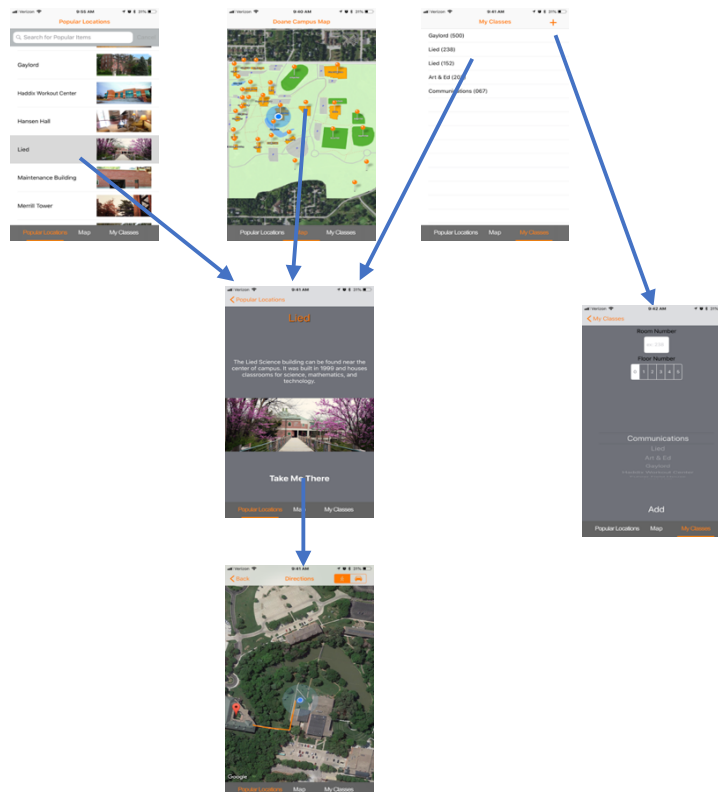


Figure 2: Doane Map Overlay

The initial view of the app is the *Map* tab. This tab provides a visual overview of the campus. The map image created using ArcMap is displayed here along with all of the key locations on campus. Each location on campus has an orange pin which allows the user to see more information. By tapping on a pin, a callout appears which allows the user to segue to the details view. As explained previously, the user can choose to navigate to the “Popular Locations” or “My Classes” view with the bottom tab bar.



Figure 3: Map View

The *Popular Locations* view is pictured below. From this view, the user can scroll through the complete list of locations at the university’s campus. Each cell in the table contains the name of the location as well as a smaller thumbnail. If the user is having trouble finding a location, they can use the search bar to filter the list based on keyword. From this list, the user can then select the desired location. Tapping on a location cell takes the user to the “Details view”.

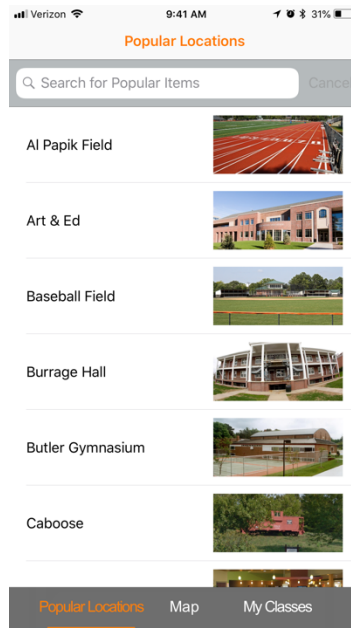


Figure 4: Popular Locations View

The *My Classes* view is shown below as well. This view displays a table of the user's classrooms. Initially, this list is blank until it is added to. Each user has the ability to customize their list of classrooms to match their class schedule. By clicking the "+" button in the top right, they can store the building, floor level, and room number for a location. Selecting a classroom from the list takes the user to the "Details" view.

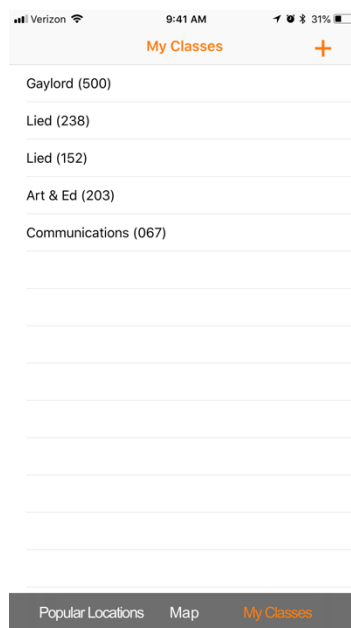


Figure 5: My Classes View

The *Details* view, pictured below, allows the user to gain more information about the location. A short description as well as an image is shown for each different location. Each location has a unique description and image gathered from the Doane University website. From this view, the user can choose to navigate back to any of the three tabs, or to get directions to the location.

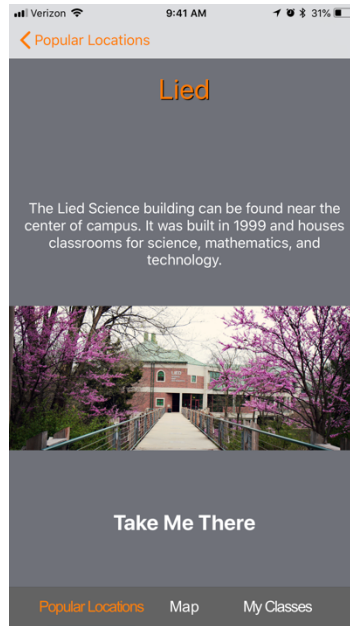


Figure 6: Details View

The *Directions* view uses the current location of the user and draws a polyline to the destination. For this to work, the app communicates with Google Map services in order to get the points to draw the polyline. As soon as the user's location has changed by approximately fifteen feet, the polyline updates. Depending on the mode of transportation, walking or driving, the polyline either utilizes roads or trails to provide the most efficient path for the user. When the user is within 100 feet of the location, the device will vibrate as well as play a notification tone to indicate that the location has been reached.

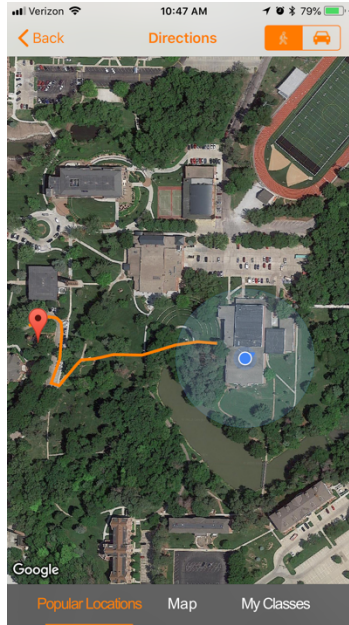


Figure 7: Directions View

Doane Map provides any student, staff member, or guest of Doane University the ability to navigate the campus with ease. This project required the combination of GIS technology, mobile app development, and the independent learning of the Xcode integrated development environment. Together, the result is a useful tool which any Doane community member can access to find their way around campus.

References

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